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XI. *On the Decompoſition of Fixed Air.*

By Smithſon Tennant, *Eſq. F. R. S.*

Read March 31, 1791.

AS fixed air is produced by the combuſtion of charcoal, it has long been thought highly probable that vital air and charcoal are its conſtituent ingredients. This opinion is confirmed by the experiments of M. LAVOISIER, from which he diſcovered that the weight of the fixed air which is formed during the combuſtion is nearly equal to that of the vital air and charcoal conſumed in the proceſs; and that the ſmall difference of weight may, with great reaſon, be attributed to the production of water ariſing from inflammable air contained in the charcoal. The compoſition of fixed air therefore ſeems to be determined, by uniting its conſtituent parts, with as much certainty as by that mode of proof alone it is poſſible to obtain. But as vital air has a ſtronger attraction for charcoal than for any other known ſubſtance, the decompoſition of fixed air has not hitherto been attempted. By means, however, of the united force of *two* attractions I have been able to decompoſe fixed air, and thus to determine its conſtituent parts in conſequence of their ſeparation.

It has long been known, that when phoſphoric acid is combined with calcareous earth, it cannot be decompoſed by diſtillation with charcoal: for though vital air is more ſtrongly attracted

attracted by charcoal than by phoſphorus, yet in this compound it is retained by two attractions, by that which it has for phoſphorus, and by that which the phoſphoric acid has for lime, ſince the vital air cannot be diſengaged unleſs both theſe attractions are overcome. As theſe attractions are more powerful than that which charcoal has for vital air, if phoſphorus is applied to fixed air and calcareous earth, the vital air will unite with the phoſphorus, and the charcoal will be obtained pure. Theſe ſubſtances, in order to act upon each other, muſt be brought into contact when red-hot; and this may be eaſily effected in the following manner. Into a glaſs tube, cloſed at one end, and coated with ſand and clay to prevent the ſudden action of the heat, a little phoſphorus ſhould be firſt introduced, and afterwards ſome powdered marble. The experiment ſucceeds more readily if the marble is ſlightly calcined, probably becauſe that part which is reduced to lime, by immediately uniting with the phoſphorus, detains it to act upon the fixed air in the other part. After the ingredients are introduced, the tube ſhould be nearly, but not entirely, cloſed up; by which means ſo free a circulation of air as might inflame the phoſphorus is prevented, whilſt the heated air within the tube is ſuffered to eſcape. When the tube has remained red-hot for ſome minutes, it may be taken from the fire, and muſt be ſuffered to grow cold before it is broken. It will be found to contain a black powder, conſiſting of charcoal intermixed with a compound of lime and phoſphoric acid, and of lime united with phoſphorus. The lime and phoſphoric acid may be ſeparated by ſolution in an acid and by filtration, and the phoſphorus by ſublimation.

Charcoal, thus obtained from fixed air, appears in no reſpect to differ from the charcoal of vegetable matters. On deflagrating

ting a little of it in a ſmall retort with nitre, fixed air was immediately reproduced.—Since, therefore, charcoal, by its ſeparation from fixed air, is proved to be one of its conſtituent principles, it can hardly be doubted, that this ſubſtance is preſent whenever fixed air is produced; and that thoſe experiments, from which it is ſuppoſed that this acid may be formed without the aid of charcoal, have not been conducted with the requiſite caution.

As vital air is attracted by a compound of phoſphorus and calcareous earth more powerfully than by charcoal, I was deſirous of trying their efficacy upon theſe acids, which may from analogy be ſuppoſed to contain vital air, but which are not affected by the application of charcoal. With this intention I made phoſphorus paſs through a compound of marine acid and calcareous earth, and alſo of fluor acid and calcareous earth, but without producing in either of them any alteration. Since the ſtrong attraction which theſe acids have for calcareous earth tends to prevent their decompoſition, it might be thought that in this manner they were not more diſpoſed to part with vital air than by the attraction of charcoal. But this, however, does not appear to be the fact. I have found, that phoſphorus cannot be obtained by paſſing marine acid through a compound of bones and charcoal, when red-hot. The attraction, therefore, of phoſphorus and lime for vital air exceeds the attraction of charcoal by a greater force than that ariſing from the attraction of marine acid for lime.